

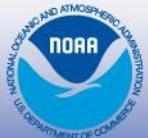
American Congress on Surveying and Mapping 2006

NATIONAL GEODETIC SURVEY

OPUS in MEXICO

Tomás Soler, Ph.D.
National Geodetic Survey

Orlando, FL. April 22-26, 2006



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New concepts about reference frames

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- Geocentric Terrestrial Reference Frames
ITRF2000, WGS84 (G1150), PZ90
- Geodetic Datum Reference Frames
NAD 83 (CORS96)
ETRS89 [ITRF89]; GDA94 [ITRF92]
- Reference frame epoch
NAD 83 (CORS96): 2002.0
SIRGAS: 1995.4
- Mexican Datum – ITRF2000, epoch 2004.0



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Rigorous Definition of a Terrestrial Reference Frame

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- Three-dimensional coordinates (x, y, z) of a set of points at certain epoch
- Velocities of these points
- The errors associated to these coordinates and velocities
- Constant monitoring of the variations of these parameters
- When necessary, apply corrections due to secular, periodic or instantaneous changes



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How are different reference frames connected?

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- 14 transformation parameters are required
(3 translations, 3 rotations, one scale
and their variations with respect to time)
- 3 epochs
 - Initial epoch
 - Final epoch
 - Epoch of the 14 parameters of the transformation



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Extra information required for a Datum

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- Besides 14 transformation parameters and 3 epochs
 - Rotation of the plate containing the Datum
3 angular velocity components;
rotation pole and angular velocity
- [NUVEL1A; REVEL]



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Three realizations of the NAD 83 datum

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- NAD 83 (CORS96)
 - epoch 2002.0: Conterminous states
 - epoch 2003.0: Alaska
- NAD 83 (PACP00)
 - epoch 2002.0: Hawaii
- NAD 83 (MARP00)
 - epoch 2002.0: Guam



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The Mexican Datum Through History

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- NAD 27
Classical two-dimensional datum
- ITRF92, epoch 1988.0
First definition of datum using GPS
- ITRF2000, epoch 2004.0
New revised definition using GPS



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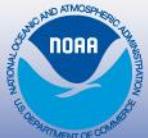
How is the Mexican datum materialized in practice?

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OPUS:

On-line Positioning User Service

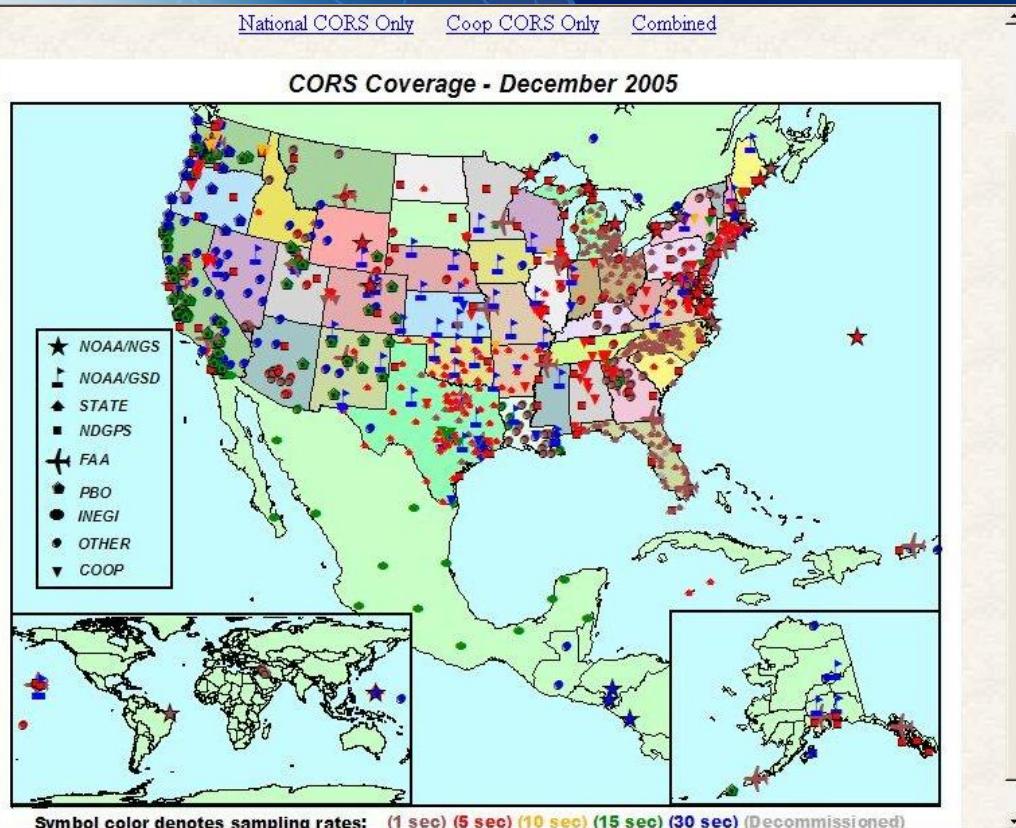
<http://www.ngs.noaa.gov/OPUS/>
ngs.opus@noaa.gov



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OPUS covers now the North American continent

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- On-line Positioning User Service
- Rapid access to accurate GPS-derived coordinates in North America



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Geographic location of the Mexican CORS (RGNA)

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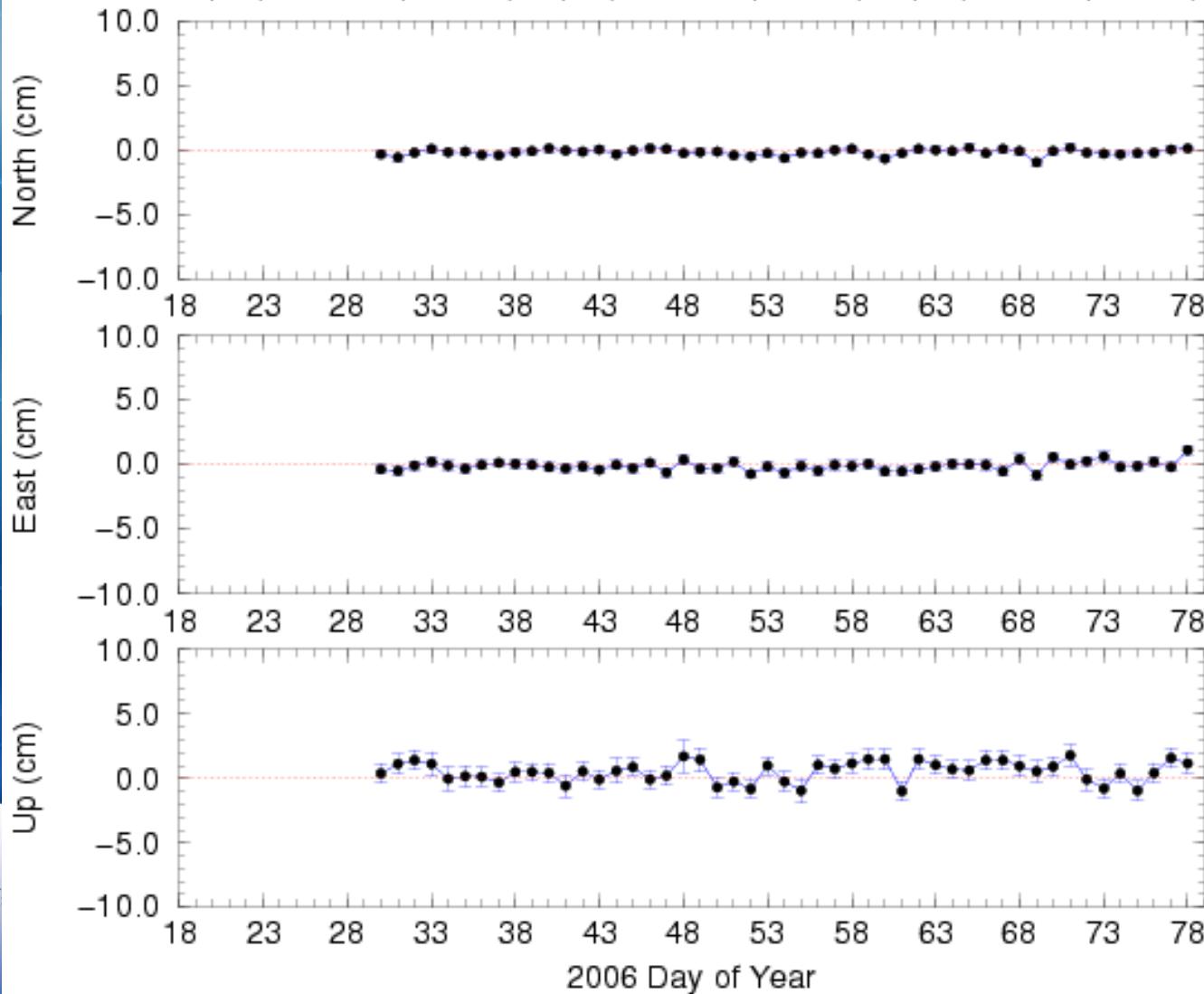
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60 day variation of Toluca coordinates

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TOL2: Daily minus Published ITRF00 Position

$$N(\text{cm}) = -0.13 (+-0.24) \quad E(\text{cm}) = -0.14 (+-0.34) \quad U(\text{cm}) = 0.50 (+-0.76)$$



N

Mexican OPUS Output

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NGS OPUS SOLUTION REPORT

=====

USER: Usuario@noaa.gov
RINEX FILE: ineg0620.06o

DATE: March 08, 2006
TIME: 20:06:01 UTC

SOFTWARE: page5 0601.10 master13.pl
EPHEMERIS: igr13645.eph [rapid]
NAV FILE: brdc0620.06n
ANT NAME: TRM29659.00 NONE
ARP HEIGHT: 0.0705

START: 2006/03/03 00:00:00
STOP: 2006/03/04 00:00:00
OBS USED: 46659 / 46895 : 99%
FIXED AMB: 117 / 133 : 88%
OVERALL RMS: 0.017 (m)

REF FRAME: ITRF00 (EPOCH:2004.0000)

ITRF00 (EPOCH:2006.1686)

X:	-1260435.662 (m)	0.005 (m)	-1260435.686 (m)	0.005 (m)
Y:	-5788547.234 (m)	0.007 (m)	-5788547.236 (m)	0.007 (m)
Z:	2360340.065 (m)	0.012 (m)	2360340.051 (m)	0.012 (m)

LAT:	21 51 22.15296	0.010 (m)	21 51 22.15245	0.010 (m)
E LON:	257 42 56.86964	0.006 (m)	257 42 56.86884	0.006 (m)
W LON:	102 17 3.13036	0.006 (m)	102 17 3.13116	0.006 (m)
EL HGT:	1887.945 (m)	0.011 (m)	1887.946 (m)	0.011 (m)

UTM COORDINATES

UTM (Zone 13)

Northing (Y) [meters]	2419383.055
Easting (X) [meters]	780685.196
Convergence [degrees]	1.01169463
Point Scale	1.00057359
Combined Factor	0.99965074

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE (m)
DH8191	COL2 COLIMA CORS ARP			324767.3
DH8716	MTY2 MONTERREY CORS ARP			472264.6
DH8722	TOL2 TOLUCA CORS ARP			395422.6



Nation

Mexican Geoids

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- In 1997 NGS computed for INEGI the gravimetric geoid model Mexico97
- Recently INEGI using software and techniques from the University of New Brunswick developed a submetric geoid model named GGM05
- This is the geoid that should be used in all orthometric calculations inside Mexico
- Interactive results are available through the Web

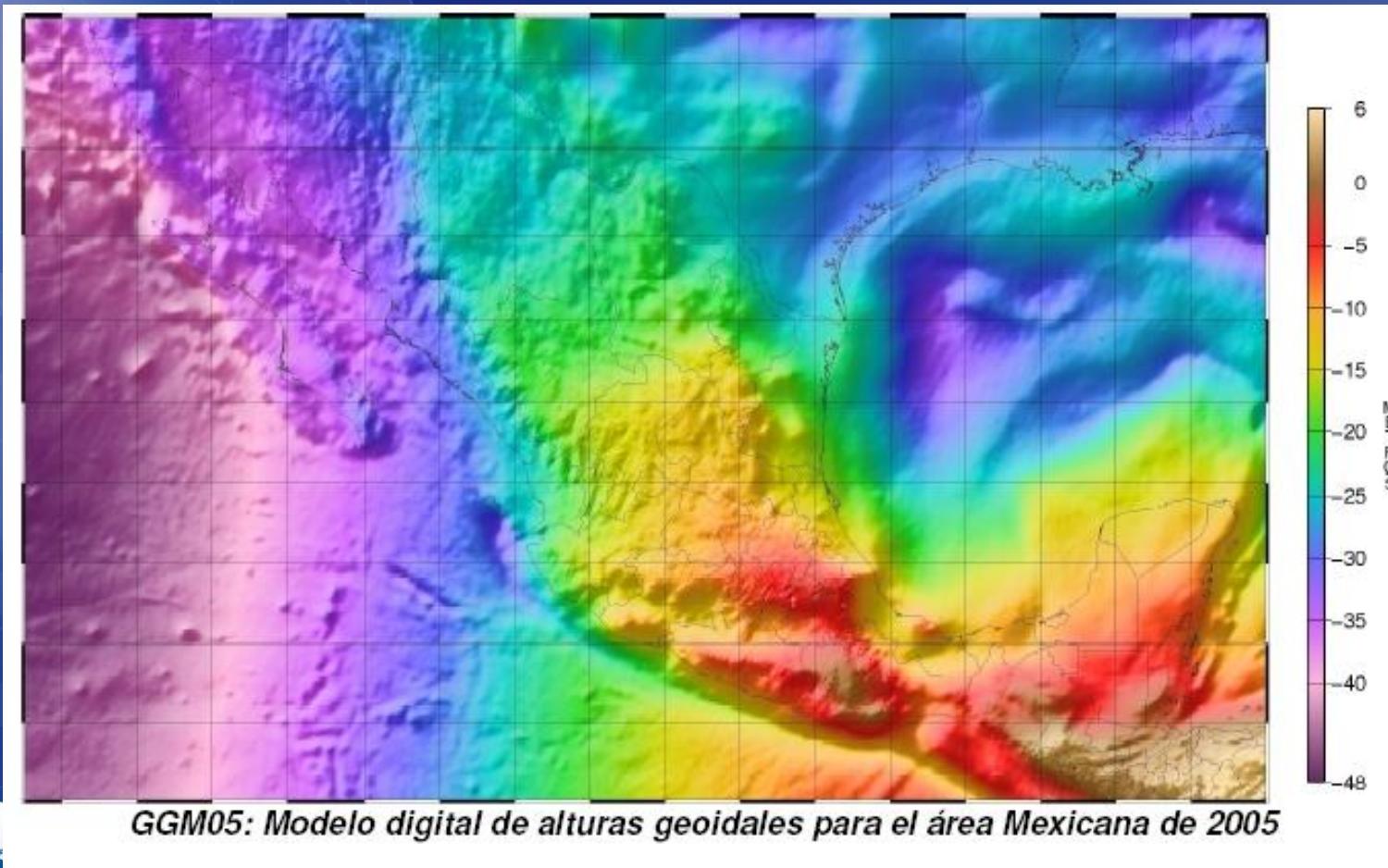


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New Mexican Geoid (GGM05)

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- <http://mapserver.inegi.gob.mx/SIAG/?c=692>



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Interactive geoidal height calculation in Mexico

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INSTITUTO NACIONAL DE ESTADÍSTICA
GEOGRAFÍA E INFORMÁTICA



Sistemas Nacionales Estadístico
y de Información Geográfica



Interpolación de Alturas Geoidales

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Introduzca las coordenadas geográficas del punto de interés

Latitud: ° ' ".

Longitud: ° ' ".

Altura geoidal

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